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AUTHOR Walker, Clinton B.
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ABSTRACT

Based on a review of standardized tests and competency assessment instruments, recommendations are made for identifying and selecting standardized tests to help secondary vocational instructors to develop students' basic skills. Chapter 1 focuses on identifying diagnostic tests of basic skills in reading, mathematics, and communication. It discusses the concept of diagnosis and criteria for selecting tests. Four types of diagnostic tests are described: (criterion-referenced, norm-referenced, custom-made or made-to-order, objectives-based item banks), and suitable tests of each type are named. How diagnostic testing will be presented in the Resource and Teacher Guides of the project, Teaching Basic Skills Through Vocational Education, is considered. Chapter 2 focuses on competency instruments to assess students' basic skills. It reviews requirements faced by students for proficiency in basic skills and then discusses each set of requirements in terms of the competency instruments recommended for its assessment. Recommendations are made for inclusion of assessment instruments in the Guides. Appendixes include a list of norm-referenced tests that were screened out, format for test review, list of tests on basic skills that have vocationally relevant testing materials built in, and references related to readability analysis. (YLB)

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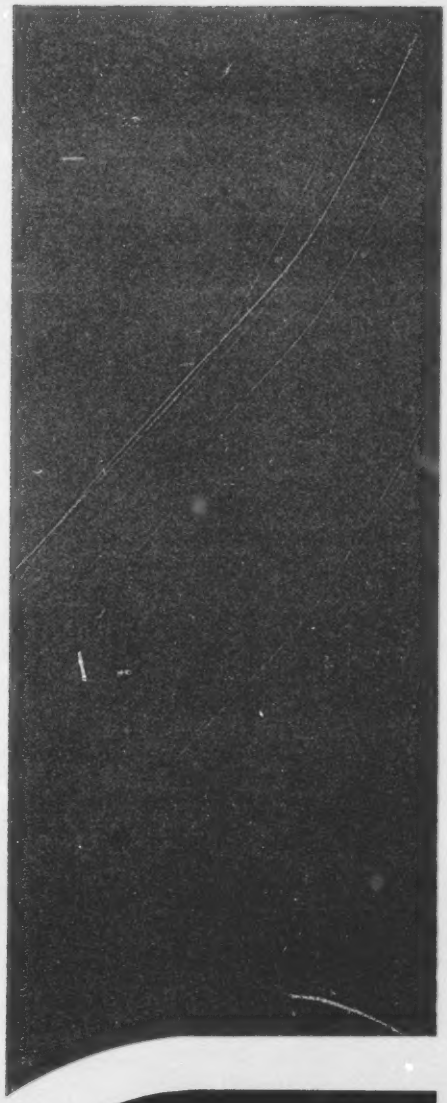

TEACHING BASIC SKILLS THROUGH VOCATIONAL EDUCATION

TECHNICAL REPORT

Selected Standardized Tests and Assessment Instruments for Measuring Occupational Competencies

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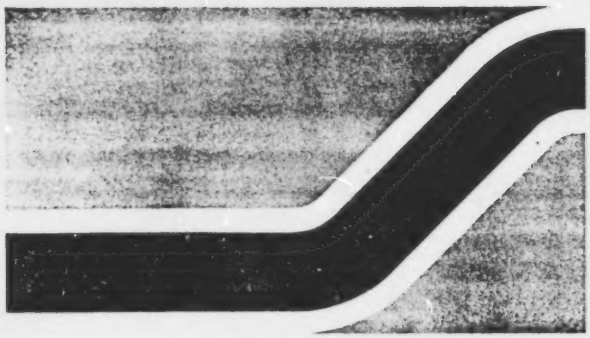

TEACHING BASIC SKILLS THROUGH VOCATIONAL EDUCATION

SELECTED STANDARDIZED TESTS
AND
ASSESSMENT INSTRUMENTS FOR
MEASURING OCCUPATIONAL COMPETENCIES

Clinton B. Walker

Cornell Institute for Occupational Education
Ithaca, New York

April 1980

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PREFACE

This paper reports the research and findings for Tasks D and F of this project, Basic Skill Development Through Vocational Education. Task D concerns the selection of standardized tests of basic skills for purposes of diagnosis. Task F focuses on assessment instruments for measuring basic skills related to occupational competencies. The purpose of both tasks is to identify procedures and materials for testing which will help secondary vocational instructors to develop the basic skills of their students.

Standardized tests which are recommended for use in vocational education settings are listed and described in Chapter One. These recommendations are carried to the point of specifying how diagnostic testing will be presented in the project's Resource and Teacher Guides.

The second chapter focuses on competency instruments which will aid vocational educators in assessing the basic skills of their students. This chapter begins with a brief description of the requirements faced by students for proficiency in basic skills. Then each set of requirements is discussed in terms of the competency instruments recommended for its assessment. Finally, recommendations are made for the inclusion of assessment instruments in the project's Resource and Teacher Guides.

This paper ends with four appendices. The first two concern standardized tests (i.e., those screened out after review, and formats for review of tests). The third appendix lists texts which have vocationally relevant testing materials built in. The fourth appendix lists references related to readability analysis.

Thanks go to C. Walker since an important aspect of the Basic Skill Development Through Vocational Education project has been the careful review of the standardized tests and competency assessment

instruments. The results of this work which are reported in this paper form a firm basis for the major project deliverables, the Resource and Teacher Guides. Thanks also go to L. Snyder for her competent typing of the final draft of this paper.

James A. Dunn
Principal Investigator and
Director, Cornell Institute for
Occupational Education

CHAPTER ONE

STANDARDIZED TESTS (TASK D)

This task consists of identifying diagnostic tests of basic skills in reading, mathematics, and communication. Unresolved issues regarding the use of diagnostic tests in vocational programs are discussed and recommendations for their resolution are made. After introducing the concepts of diagnostic testing and basic skills, this paper discusses criteria for selecting tests to be described in the project's Guides. Then, four types of diagnostic tests are described, and the suitable tests of each type are listed by name. Finally, means of using such tests to improve vocational instruction are recommended.

The Concept of Diagnosis

Diagnostic testing of basic academic skills involves the use of tests which provide a profile of strengths and needs for each student. These tests have separate sets of items for each of a fairly large number of objectives (i.e., 10-40) or otherwise teachable skills, the objectives being stated in terms of reading or mathematics curriculum. By reporting a separate score for each objective, these tests enable interpretation in terms of what students can and cannot do. Diagnostic tests contrast with survey tests, which give scores for a few broad domains of achievement such as reading comprehension or problem solving.

A diagnostic test in reading or mathematics is really a battery of subtests. Its usefulness for instruction comes first from the specificity with which the basic skills are defined. Skills are defined narrowly and explicitly enough so that scores for individual objectives can be related to specific lessons or instructional activities. That is, diagnostic tests support instructional prescription. As an aid in prescription, a number of test publishers sell curriculum guides which cross-reference their test's objectives to the scope and sequence charts and to the lessons in major series of teaching materials.

A second property of diagnostic tests which supports instruction is their rapid reporting of scores to teachers. Many of these batteries are equipped with templates for easy scoring on-site, and the machine scoring by publishers is faster than that for conventional survey testing. Thus, the results are more available in the optimal time frame for instructional planning.

Criterion-referenced tests (CRTs) and some norm-referenced tests (NRTs) are designed to support diagnosis. The main difference between these two types of tests is in the form of score they emphasize. Percent correct or proficient/not proficient are the primary types of scores for CRTs, whereas comparative measures such as percentile norms, grade-level equivalents, quartiles, and stanines are commonly reported for norm-referenced tests. The distinction is like the difference between a runner's time for running a race and the runner's place of finish. The runner's time is an absolute or criterion-referenced measure of achievement, while the runner's place is a comparative, or norm-referenced measure of achievement. The absolute or criterion-referenced measure is a more direct index of what a pupil knows or can do. In this sense, criterion-referenced tests are generally more useful in competency-based programs.

Criteria for Selecting Diagnostic Tests

Many widely known tests of basic skills are not useful for diagnosis and prescription. Published reviews of most standardized tests have generally been critical of their technical merits, and teachers are generally critical of these tests for giving scores that are too general to be diagnostic. Moreover, some tests are explicitly advertised as diagnostic, while most are not. In response to this situation a set of criteria for screening tests was established for this project. These criteria, shown in Figure 1, will be listed in the Resource Guide.

Figure 1

CRITERIA FOR SCREENING DIAGNOSTIC TESTS

1. Ready availability. For maximum usefulness to vocational teachers, tests need to be available on call. This criteria excludes secure tests, that is, tests that are not readily available to school systems, and fugitive tests such as those that are printed only in research journals.

2. Appropriateness of grade-level coverage. Only tests covering levels of skill that are remedial for high school students will be included. Each of the tests cited in the Resource Guides cover at least part of this range: fourth through eighth grade level of skills.

3. Adequacy of the development process. Only tests which have been reviewed during their development, field tested, and shown to be reliable will be included.

4. Prescriptive usefulness. In order for tests to support educational prescription, they must be truly diagnostic of skills and deficits. To be diagnostic, tests must give scores for a variety of explicit and teachable objectives and they must have generally more than two items per objective. This latter requirement reduces error of measurement, which has an inverse relation to the number of items that measure the individual skill.

5. Availability as a battery. Tests are sold in a variety of packages ranging all the way from brief survey forms to collections of many individual test forms. Included here are tests which can measure relatively many objectives in a small number of sittings.

6. Suitability for testing groups of students. At least two of the otherwise suitable diagnostic tests on the market require one-on-one testing. Such tests require a high investment of adult time in return for scores on small numbers of students. They are excluded here on grounds of practicality.

Two categories of tests discussed below require some relaxation of these criteria: made-to-order tests and tests of writing. A made-to-order test is prepared to measure a unique set of objectives. Field testing of every such test prior to its use would be prohibitively expensive, so the requirement for evidence of reliability must be relaxed here. Nevertheless, an indirect control on quality of these tests can be exercised: by including only those custom-made test services whose ready-made tests in reading and mathematics show evidence of reliability. This practice is sound, because the publishers use the same basic pools of test items for their ready-made and made-to-order tests.

Tests of writing raise another issue. Most tests which purport to measure writing skills do not use actual samples of students' writing. These tests are often diagnostic in the sense that one test form will give scores for several specific skills, such as punctuation, capitalization, usage, sentence structure, spelling, and the like. However, multiple choice tests show only whether students can recognize the differences between better and poorer writing, not whether students can produce passable writing. There appear to be only two carefully developed tests of writing samples in the right grade range, each of which has a multiple choice component as well. These two are included in the listing below, even though the validity of the scoring rests in the hands of the user.

Recommended Diagnostic Tests

Search and Screening

To develop a list of suitable diagnostic tests, a search and screening of existing tests was carried out. The search relied mainly on catalogs of test publishers and the latest books of test reviews as sources. These books include Buros' Eighth Mental Measurements Yearbook, CSE Elementary School Test Evaluations (Hoepfner, 1976), CSE Secondary School Test Evaluations (Hoepfner, 1974), and the CSE Criterion-Referenced Test Handbook (Walker, 1979). Conversations with Joan Knapp of Educational Testing Service and Ralph Hoepfner, now at Systems Development Corporation,

supplemented this search. Test materials were either ordered for review at Cornell Institute for Occupational Education or screened at the Cornell Guidance and Testing Center. Technical adequacy of tests was judged by the criteria in the SCE volumes and diagnostic power was judged by examining each test's form for reporting individual pupils' scores.

Types and Names of Diagnostic Tests

Several types of diagnostic tests met the screening criteria and warrant recommendation. These include both tests that were originally designed to support instruction and tests which have had diagnostic power added after the fact through the medium of detailed score reports. Each type is described briefly below, and the examplars which met the screening criteria are named.

Criterion-referenced tests. The term criterion-referenced test refers here to tests whose items measure explicit objectives and which provide absolute scores for each objective. Items are selected for these tests mainly on the basis of content validity, that is, their congruence with the test's objectives. The objectives are selected on the basis of expert judgment and an analysis of the instructional materials. Around 60 such tests of basic skills are on the market now, most of which were screened out for not having any evidence of reliability. The following subset of criterion-referenced tests met the screening criteria, hence are recommended:

From CTB McGraw-Hill

- Assessment of Skills in Computation
- Diagnostic Mathematics Inventory
- Everyday Skills Test in Reading and Mathematics
- Performance Assessment in Reading
- Prescriptive Reading Inventory
- Tests of Everyday Writing Skills

From Educational Commission of the States

- NAEP Released Exercises in Reading and Mathematics

From Educational and Industrial Testing Service

- Tests of Achievement in Basic Skills (Mathematics)

From NCS Education Systems

- Wisconsin Design for Reading Skill Development: Study Skills

From Psychological Corporation

- Metropolitan Achievement Tests' Instructional Tests
- Stanford Diagnostic Mathematics Test
- Stanford Diagnostic Reading Test

Norm-referenced tests. Norm-referenced tests are typically designed to give scores on a few broad domains, such as reading comprehension, in terms that tell where a student ranks relative to other students. That is, the scores are in terms of rankings rather than degree of proficiency. The skills to be tested are chosen on the basis of experts' opinions and analyses of instructional materials. Once test items are written, they are selected on the basis of their statistical properties. Specifically, items are chosen to have a mid-range of difficulty at the target grade level and to correlate strongly with individuals' scores for the whole set of items. This selection process has the intent and result of maximizing reliability of measurement. However, it has the cost of excluding skills which are generally well taught and well learned. Thus a great deal of the domain of basic skills is not covered.

The main difference between criterion-referenced and norm-referenced tests is not in the tests themselves, but in their scores and interpretation. The line between the two types of test blurs when normative scores are provided for each objective of a criterion-referenced test and when raw scores are provided for small item clusters of a norm-referenced test. Absolute or competency-based scores are generally more relevant in vocational education, but normative scores can be diagnostic if they are for specific teachable skills.

Three types of norm-referenced tests of basic skills were reviewed for possible inclusion: the most widely used ones (e.g., Sequential Tests

of Educational Progress Battery), tests recommended for our review by other professionals (e.g., Test of Adult Basic Education), and tests whose titles suggested that they are relevant (e.g., Diagnostic Tests in Mathematics). The following tests are recommended since they met the screening criteria:

From CTB McGraw-Hill

- California Achievement Test
- Comprehensive Test of Basic Skills
- Test of Adult Basic Education

From Educational Testing Service

- ETS Basic Skills Assessment

From Psychological Corporation

- Metropolitan Achievement Tests: Survey Battery
- Stanford Achievement Tests
- Test of Academic Skills

From Science Research Associates

- SRA Achievement Test Series

A listing of tests screened out of the category of acceptable norm-referenced tests is given in Appendix A. The list of acceptable ones is short because few of the publishers make truly diagnostic scores available. Only a small number of publishers bridge the gap between broad comparative scores and instructionally useful scores. They have done this by dividing the total set of test items into a fairly large number of homogeneous clusters, then providing separate scores for each of these clusters. These subscores relate more directly to instructional planning than do total test scores, because they more closely correspond with lessons or instructional activities.

Custom-made or made-to-order tests. A number of commercial publishers will custom-make tests in response to special orders from test users. The publisher provides a list of objectives for which it has test items

in stock, and the user chooses from this list the objectives for its made-to-order test.

The unique advantage of this type of resource is its ability to match almost any curriculum with a wholly relevant test. In contrast, ready-made tests are designed to fit many curricula in a general way, but no single curriculum very well. Not only could a customizing service create a test to fit a conventional curriculum in reading or mathematics, but also it could create a test of basic skills for any particular occupation.

There are two disadvantages to these services. First, the lead-time for acquiring custom-made tests is fairly long: six to eight weeks from receipt of the order. Second, the cost is much higher than that for ready-made tests, due mainly to the requirement for a sizeable minimum order.

One readily available solution to those problems is to purchase a non-commercial item bank for the purpose of custom-making tests on-site. Item banks are discussed shortly below. Two other possible remedies would require a greater degree of administrative leadership. For one, a consortium of test users could be formed among users who have a common need. They could achieve economies of scale in buying custom-made tests and then stock the tests at member schools for ready use. The second remedy would involve persuading a commercial publisher that there is a market for new, vocationally relevant tests of basic skills. The publisher could make up such tests from its customizing service and carry them as regular catalog sale items (i.e., ready-made).

Of the six commercial customizing services that were found, three belong to publishers whose parallel ready-made tests are well field tested. These three are:

- Mastery Custom Tests
  by Science Research Associates,
- ORBIT
  by CTB McGraw-Hill, and

- SCORE Criterion-Referenced Tests
  by Houghton-Mifflin

Objectives-based item banks. An item bank is a large collection of test items that can be selectively combined into tests as the user wants. Since the items are grouped according to the objectives they measure, the banks are called objectives-based. Three of these banks are for sale to districts and schools, thus they are a resource for custom-making tests on-site. Those three banks, which meet the screening criteria, are the following.

- Item Banks Package
  by Northwest Evaluation Association
- IER Criterion-Referenced Objective and Item Bank
  by Institute for Educational Research
- Resource Items for Minimal Competency Testing
  by Education Commission of the States

These banks cover a wide range of objectives and grades in reading and mathematics. The first two, which were developed by consortia of school districts, have been Rasch scaled. Thus, the tests they yield give scores in terms of both instructional objectives and level of functioning.

A Format for Test Reviews

The Resource Guide will list and review diagnostic tests. Several different formats are available for the test reviews including prose, numerical ratings of the characteristics of tests, qualitative ratings, and a mixture of these. The most influential reviewer of tests, Buros (1978) has a mixture of descriptive information (e.g., prices, levels, date of publication, publisher) in rather abbreviated, standard form along with critical essays. Different tests are reviewed by different authors in Buros, the content of the essays varying considerably from author to author. In contrast, the CSE reviews of norm-referenced tests (Hoepfner, 1974; 1976) are given in uniform two-dimensional matrices of numbers. The numbers, which demand a great deal of interpretation, are ratings of the quality of a large number of test features. A third format combines

qualitative rating of test features with description of a standard set of features such as levels, prices, scoring options, and the like.

In this project diagnostic tests have already been evaluated, in effect, during the screening. Thus, an evaluation component is not needed in the Resource Guides. It is very desirable for the reviews to present information in a standard, readily accessible form so that readers can find what they need to know and can compare tests. The form should be easy to use and relevant to the user's needs.

Two types of users are envisioned for the test reviews: a consumer of test results and a person who is involved in selecting tests. For the former, a diagnostic score report and guidelines for interpreting it will be needed. It is likely that some guidelines for interpretation will apply to all tests and some will be test-specific. The former may go in a Teacher Guide. For the test selector, a thorough description of each test will be useful in addition to the sample score report. A recommended model of one such test review is given in Appendix B.

Recommendations For the Resource and Teacher Guides

Both the Resource and the Teacher Guides will be written on the thesis that vocational teacher are consumers of test results, but are not generally test administrators or main resource persons in reading and mathematics. The Teacher Guide will be designed to support, among other things, diagnosis in ongoing vocational instruction, while the Resource Guide will have information that will support test selection and the planning of a testing program. Audiences for the Resource Guide would include curriculum, counseling, and testing specialists.

A basic issue in the discussion of testing is whether vocational education is to be the means for improving basic skills or instruction in basic skills is to be the means for improving students' performance in their

vocational programs. This issue bears not only on the aims of the project, but also on whether the focus of diagnostic testing will be basic skills in general or entry-level basic skills for specific jobs (or sets of jobs). Rather than recommend a choice, we will suggest a criterion for making the choice. In general terms, the criterion is: what is most likely to make a difference in students' learning. Specifically, the choice should make sense to vocational educators in that it should fit their skills, resources, work load, and aspirations for their students. Otherwise, they are likely to reject the diagnosis of basic skills.

Resource Guide

The Resource Guide will have sample diagnostic score reports, advice on interpreting each of the tests listed above, and recommendations for making a testing program meet the needs of vocational teachers. The recommendations will refer to selecting tests, timing of testing, and means for facilitating the use of scores.

For instructional purposes the best type of test is one that permits real diagnosis by reporting a profile of specific strengths and needs. The differences between diagnostic and other tests will be explained, and the non-diagnostic nature of many familiar tests will be pointed out. This point will be made by reference to samples of forms for reporting individual pupils' test scores. Differences between ready-made and custom-made tests will be discussed, and the use of the latter will be explained.

Advice for interpreting each test will be based on a number of factors, including the numbers of items per objective, specificity and number of objectives, and the data on the test's (or its objectives') reliability. The output will be types of decisions which each test will support. An important theme throughout will be the imperfect nature of test scores and the flexibility with which they must be interpreted.

Advice for facilitating the use of test scores will refer to methods for identifying job-relevant or generic basic skills, the potential role of basic skills in writing Individual Education Plans, resource persons who could aid in making instructional decisions, and how and when these persons could be most helpful. Alternatives for getting test results or prescriptive information into the hands of vocational teachers will be included as well.

Teacher Guides

Information in the Teacher Guides will differ from that in the Resource Guide in that it will deal with diagnostic tests in general, rather than specific tests, and will include some less formal diagnostic processes. The three main topics will be decision making, clinical indicators of deficiencies in basic skills, and informal diagnosis. Decisions about students' strengths and needs can be made by comparing test scores to a standard of proficiency, comparing scores with the typical scores of local criterion groups (i.e., local students who are clearly proficient, marginal, and clearly needy), or by using absolute and normative scores to help interpret each other.

Clinical indicators are behaviors by which a student reveals weaknesses in basic skills. These include such clues as avoiding reading, doing reading assignments very slowly, consistently mispronouncing words (not to be confused with having a dialect), trying to get other students to do computations, and making errors in following written or oral directions. Informal diagnosis would not involve the assessment of skills so much as the assessment of the student. A method of last resort, it would involve comparing a student's scores on standardized tests with scores of local criterion groups. Rather than pinpoint specific strengths and needs it would serve to confirm the teacher's judgment about an individual's overall need for remediation.

CHAPTER TWO
ASSESSMENT INSTRUMENTS (TASK F)

Vocational students are required to use basic skills with proficiency at three early points in their lives: in their vocational programs, in entry-level jobs, and in the role of adults. This section reviews these demands for proficiency and reports on a search for materials to support the teaching and testing of occupational basic skills. Recommendations for the project's Guides are made throughout.

Basic Skill Requirements

Demands Made by Occupational Programs

Vocational students have to be able to read and communicate in order to succeed in their occupational programs. Three sources of difficulty for students are technical vocabulary, text, and graphics. Materials to help vocational teachers with each of these are discussed next.

Technical vocabulary. In entering any specialty one has to master the technical vocabulary, that is, the verbal tools of the trade. These terms encode the basic concepts of a specialty and enable effective communication about work. As such they comprise basic occupational skills which students must master to succeed in any program. The importance which vocational teachers assign to vocabulary is shown by a survey of over 400 teachers in eight different occupational program areas in Florida (Redmann, 1979). These respondents rated the importance of 58 skills in teaching reading. Out of the six content skills which earned the highest ratings, four relate to vocabulary and the use of sources like glossaries and dictionaries.

As part of Task F, a search was conducted for resources that identify basic occupational terms and tell how to teach them. One major work of

very high quality was found: the Vocational Reading Power program. It has both a module on how to teach vocabulary in a content or program area and a set of key word glossaries in specialties from Advertising to Welding. The glossaries give multiple meanings for many terms, guides to pronouncing each term, and some illustrative diagrams. So that vocational teachers will not be limited to these sets of terms, the module on teaching vocabulary tells how to identify special terms in any text. In addition to this one comprehensive source, four texts for building vocational vocabulary are cited in Appendix C.

It is recommended that this project not try to replicate the efforts of Vocational Reading Power (VRP), but rather use its materials as models and resources. In the present project's Guides, methods for identifying and teaching vocabulary should be described, following and explicitly crediting VRP. Excerpts from the VRP glossaries should be given both for illustration and for directing the vocational teacher to the original sources.

Another type of vocabulary should be included in the project's Guides, that is, the basic terms of mathematics. Often students' difficulties in mathematics are verbal in origin, so vocational teachers should be made aware of this problem and given resources to deal with it in the Teacher Guides.

Text. Reading comprehension is affected by both the student's skill and the difficulty of the text. Difficulty, often called readability, can be measured with standard methods which were developed by authorities like Fry, Flesch, and Chall. These methods show that text becomes harder to read, in general, as sentences get longer and as words get longer and less familiar. By using any of these methods, one can compute an index of difficulty that is expressed in grade-level terms.

Vocational educators may find readability measures useful in several ways. First, teachers may select texts at a level of difficulty that is

right for their students. Next, they may plan the length and type of assignments according to the difficulty of the materials. Finally, they may adjust their teaching methods to accommodate the materials' difficulty.

A search was conducted for practical sources on readability. Two types of sources were found: methods for analyzing the difficulty of text oneself, and existing analyses of the readability of vocational texts. Appendix D lists these sources.

In vocational education, the Vocational Reading Power project (Appendix D) uses a computer program to analyze text. An operator types the text at a computer terminal, and the program gives an analysis in terms of several measures of reading difficulty. A somewhat different computer program for analyzing readability is available from authors at the Pensacola Junior College (Appendix D).

Not only are the computer programs available, but three extensive analyses of vocational texts have been conducted and reported. One, by the VRP staff, analyzes over 160 vocational texts which are popular in Minnesota. For each text four readability indices are given and a measure of the variation in reading difficulty within each text is provided. This report is not yet available to the public. A second analysis, done by the Bloomfield (CT) High School Reading Department, covers more than 200 vocational texts that are used in Connecticut. For each text it lists the title, Flesch readability index, an index of usability, authors, publisher, date of copyright, and evaluative remarks. An earlier analysis of vocational texts, done by the Cornell Institute for Occupational Education, is also listed in Appendix D.

One peculiarity of vocational reading material weakens the usefulness of standard readability analyses: the technical vocabulary in vocational texts contains a lot of long words. Long words inflate readability measures both by being long and by being uncommon in <u>general</u> reading matter. There are, however, two reasons why vocational terms probably do not

increase reading difficulty for vocational students as they do for the general reader. First, those terms are used commonly in vocational contexts. Second, technical vocabulary should be a separate target of vocational instruction. When it is, that practice makes the reading material less difficult for those students, irrespective of its measured reading level.

This discussion supports several concrete recommendations for the project's Guides. One is that technical vocabulary be stressed in the Teacher's Guide as a potential obstacle to reading, and that methods for teaching technical terms should be stressed as leading to both fluency and literacy in the vocations. Second, methods for doing readability analyses should be given in the Resource Guide, as should citations of computer programs for such analyses. But an adjustment to the traditional methods should be provided. This adjustment will treat technical terms as short words in the instructional units following the unit where they are introduced. Finally, summaries of the published analyses of readability should be reprinted in the Resource Guide for ready reference, along with suggestions for using such data.

Graphics. Much of the information in instructional materials for vocational classes is in the form of charts, diagrams, pictures, and other graphics. Students' understanding of their lessons can be as much affected by the comprehensibility of the graphics as it is by the readability of the text. Factors affecting the comprehensibility of graphics have the potential to inform the selection of materials, planning of assignments and modification of teaching methods.

Despite this line of reasoning, three factors support the recommendation to omit from the project's Guides any treatment of the difficulty of graphics. First, vocational teachers rate reading assignments in graphics as being relatively unimportant. In the Florida study cited earlier, the six teaching skills related to graphics (e.g., pictures, sketches, figures, diagrams, blueprints, maps, cartoons, graphs, charts, schedules, tables) ranked an average of 49th out of 58 in importance.

Next, a search of articles on the construct visual literacy shows that it has not yet developed a consensus or any strong instructional implications (e.g., Wittich and Schuller, 1973). Finally, the available sources do not specify teaching methods for overcoming students' problems in understanding graphics.

Demands Made by Entry-Level Jobs

The world of work makes its own demands on students to be proficient in the basic skills. The original intent of Task F was to find tests of job-relevant basic skills which would permit judgments to be made of entry-level competence. These tests were seen as measures of the success of remediation. The search for such tests referred to the following sources: catalogs of major test publishers; catalogs of text publishers in the vocational field; the ERIC search for Task E; research staff and bibliographies of the Regional Curriculum Coordinating Centers in Vocational and Technical Education; lists of tests from the Test Collection of Educational Testing Service; and officials of National Occupational Competency Testing Institute and the Ohio Instructional Materials Laboratory.

One body of relevant testing materials was found: test items that are built into basic skills curriculum for the vocations. Such items are called problem sets, post-tests, achievement tests, or assessments and are given at ends of units, at ends of books, in teachers' guides, or completely separately. These items were considered tests only when the answers were not given in the materials for students. Neither the reliability of these tests nor their level (entry or otherwise) is indicated in the secondary sources that were consulted. These vocational curricula with built-in tests are listed in Appendix C.

The texts listed in Appendix C will be included in the Resource Guide to help vocational teachers select materials. This listing, although useful, leaves many gaps. Another approach is open which involves a different application of resources identified earlier for diagnostic testing.

These resources are made-to-order commercial tests and item banks. Although the test items in these resources are not phrased in occupational terms, they can be selected to fit the exact basic skills of any occupation.

The services of commercial test customizers are quite expensive, owing to the size of minimum orders, and have a lag time of six weeks or more from receipt of orders. In contrast the non-commercial item banks are lower in cost and allow very quick preparation onsite of tests to order.

One recommendation is for this project to develop some prototypes of such tests and verify their acceptability and practicality with a sample of vocational teachers. Prototypes may be developed from item banks in the public domain which are on hand, such as the State of California Proficiency Assessment Sample Exercises and the Downer's Grove item bank (ERIC #s ED 066 494 through 066 501). Sample tests could be pilot tested in the formative stages of the Guides so as to inform the decision to emphasize or de-emphasize resources for custom-making tests.

On finding that these job-targeted tests of basic skills are acceptable to teachers, the project should prepare two types of supporting materials. The first is an indexing which matches entry-level jobs with their unique sets of prerequisite basic skills. The Ohio State taxonomy reported in Task E is a model for this matching device. Such an index will allow teachers to identify the job-relevant basic skills to teach and to test. Thus it will provide recipes for custom-making tests.

The Teacher's Guide should have a second aid to making up tests: a section on how to use item banks and how to set standards for passing. General advice on problems of testing (e.g., practice effects, guessing) should be given here too.

Demands Made by Adult Life

The need for competencies in basic skills to survive as an independent adult is hard to deny. Yet the fact that such skills are lacking in many

adults has caused increasing public concern and increasing pressure on high schools to produce graduates who have the minimal competencies. In response, nearly 40 states have adopted programs for testing minimal competencies and 17 of them have made a passing score on such a test a requirement for graduation from high school. These graduation tests are taken here to be proxy measures of proficiency in the basic skills needed for adult life.

Testing to award high school diplomas, and the system of objectives and tests leading up to that point, have implications for the vocational program. Vocational teachers can contribute to students' attainment of the competencies, and the students' employability may depend on their exhibiting the competencies on the test.

It is recommended that the Resource Guide include prescriptive steps to make vocational instruction and testing for graduation support each other. Based on an indexing of job-relevant basic skills, this section will direct a resource person to identify the objectives that are common to the local graduation test and to each of the jobs being learned. The resource person will then give lists of these intersecting skills to both the individual's vocational teacher and teachers who are the main source of instruction in the basic skills. Each can work from these lists to support the others' efforts.

Summary of Recommendations for the Resource and Teacher Guides

A number of recommendations for the Teacher's and Resource Guides are made in this chapter. These deal with technical vocabulary, readability of text, testing of occupational basic skills, and high school graduation requirements. Regarding technical terms, it is recommended to use high quality published work as sources and models and not to duplicate previous development efforts. Methods for teaching technical terms, including those of mathematics, should be included in the Teacher's Guide.

Two resources are recommended for use in determining the reading level

of texts: formulas (or computer programs) for doing original analyses of readability and results of analyses of vocational texts. An adjustment to traditional formulas is recommended in order to reflect the fact that vocational terms are familiar in vocational settings. The Teacher's Guide should have specific suggestions for using the output of readability studies which take account of the strengths and limitations of these analyses.

Two types of testing materials are recommended: tests embedded in texts of occupational basic skills (e.g., Basic English for Business Communication) and made-to-order tests. The former should be listed in the Resource Guide. In developing resources on made-to-order tests it would be best to pilot test some prototype instruments. A finding that teachers need and want such tests would justify our then writing directions for the use of item banks for the Teacher's Guide.

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APPENDICES

Appendix A

NORM-REFERENCED TESTS THAT WERE SCREENED OUT AFTER REVIEW

Adult Basic Learning Examination by Psychological Corporation. The ABLE gives only five scores for the range of basic skills, hence is not diagnostic. The scores are for vocabulary, spelling, reading, computation, and problem solving.

Adult Basic Reading Inventory by Scholastic Testing Service. The technical soundness of this test is not documented by the publisher.

Adult Performance Level Examination by the American College Testing Program. The APL gives only four scores in basic skills (reading, writing, computation, and problem solving), so it is not diagnostic.

Armed Services Vocational Aptitude Battery by U.S. Military Enlistment Processing Command. Only four of the twelve subtests relate directly to basic academic skills.

Diagnostic Math Test by Fran Steenburgen Publications does not offer any report of field testing for reliability.

Diagnostic Reading Scales by CTB McGraw-Hill. These are diagnostic in the area of phonics, but not in the remainder of reading. Thus their scope is not appropriate here.

Diagnostic Screening Tests: Mathematics by Facilitation House. Field testing and reliability data are not given.

Diagnostic Tests in Mathematics by Guidance Center. Field testing and reliability data are not reported.

Differential Aptitude Tests by Psychological Corporation. The DAT is not diagnostic of basic skills because most of the scores are for other variables while the scores for basic skills are given in very broad terms.

Durrell Listening-Reading Series by Psychological Corporation. In addition to having low reliability, the test is not clearly diagnostic.

Gates-MacGinitie Reading Tests by Bobbs-Merrill. The 1978 edition gives only two scores for the whole domain of reading.

GED Tests of Reading, Mathematics, and Writing Skills by Contemporary Books. The numbers of items per objective in reading and mathematics are very low, and the test of writing skills is entirely multiple choice.

Iowa Test of Basic Skills by Houghton-Mifflin. The ITBS gives only two scores each for reading and mathematics, so it is not diagnostic.

McGraw-Hill Basic Skills System is for college-bound students, thus is not at the appropriate level.

Mechanics of Written English by Purdue University Research Center does not use a writing sample.

Sequential Tests of Educational Progress by Educational Testing Service. Although this battery measures reading, writing, listening, and mathematics, there are only one or two "objectives" per area.

USES General Aptitude Battery by U.S. Employment Service. Only two of the nine scores deal with basic academic skills.

Wide Range Achievement Test by Jastak. This popular test gives only three scores for a pupil: spelling, reading, and arithmetic.

Appendix B

SAMPLE OF A FORMAT FOR REVIEWS OF TESTS

DIAGNOSTIC MATHEMATICS INVENTORY*
by John K. Gessel

DESCRIPTION

A revision of the earlier Prescriptive Mathematics Inventory, the DMI is a seven-level diagnostic testing system for grades 1.5 through 7.5 plus. The following 11 categories of skills are covered: pre-operational concepts, counting, matching, addition of single digits, addition of integers with more than 1 digit, subtraction of integers, missing addends and factors, sequences and inequalities, measurement, plane figures, and inverse and place value. The DMI has from 37 to 179 multiple choice items per level, with each item testing a separate objective. The number of choices per test item ranges from 5 to 10. For math skills at this broad level of description--"measurement," "subtraction of whole numbers with regrouping," "segments, lines, rays"--the number of skills per level varies from 11 to 39 and the number of items per skill from 2 to 8.

To support classroom instruction, the following optional materials are available: interim tests for monitoring pupils' progress during the year, learning activities guides, guides indexing the DMI to math text series, and guides to non-text teaching materials.

PRICES

Test books come in packages of 35 with an Examiner's Manual. At the upper four levels, the reusable test books are 54¢-61¢ per pupil. Machine scored answer sheets are 13¢-16¢ per pupil in sets of 50; hand scorable ones are 20¢-40¢ in sets of 25. Consumable practice exercises for leveling pupils before giving the diagnostic tests are offered for 11¢ per pupil in sets of 35. The Teacher's Guide, serving all levels, is $3.25. Examination kits are $5.50 per level, $16.00 for an all-level kit. Date of information: 1979.

FIELD TEST DATA

Field test data include point-biserials for individual items, KR-20s, test-retest reliabilities, and item difficulties. Estimated norms are optionally available.

RESOURCES FOR PRESCRIPTION

The DMI has an optional curriculum index which keys the test items and objectives to specific lessons in the following text series:

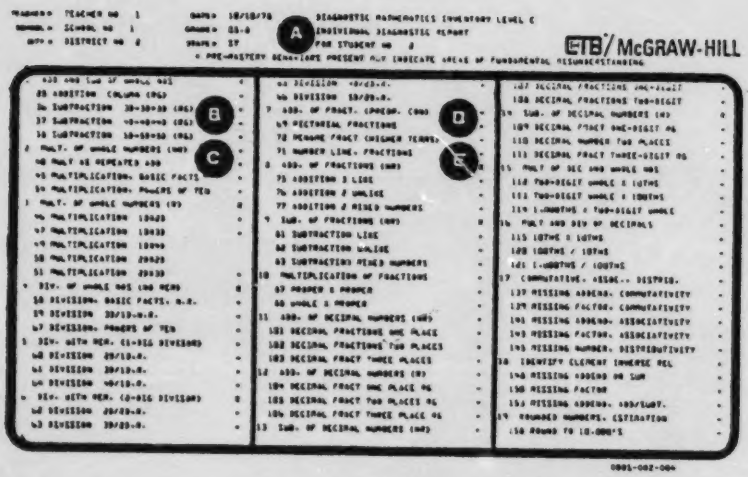
(to be listed here)

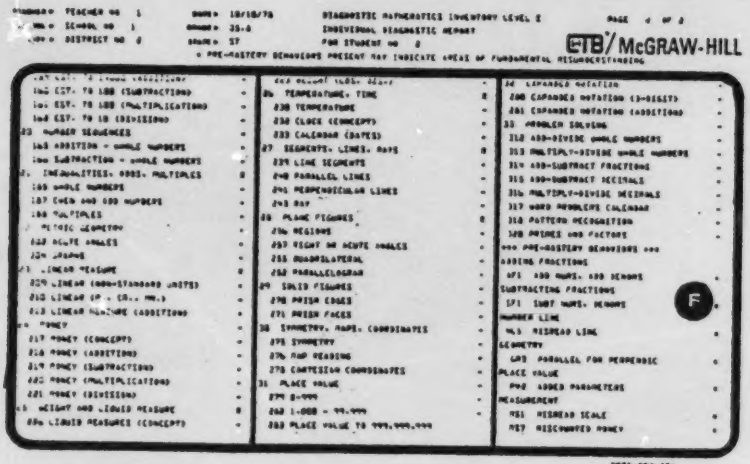
SCORING

Tests are machine scored at a cost of 70¢ to 97¢ per pupil. The basic service includes all of the following: responses, summaries by total scores of the group. For an additional cost of 15¢ and 25¢ per pupil respectively, group and individual diagnostic reports are available. Estimated norms are optionally available. Publisher says that the approximate time for returning scores to the user is 15 days from receipt.

The next page shows the form scoring will take.

*CTB McGraw-Hill, 1975





Individual Diagnostic Report

(Optional Service. I-112 IDR)

The Individual Diagnostic Report provides a record for use in improving each student's skills. It is also a record-keeping device as the students work through the objectives and take interim tests to demonstrate newly achieved mastery.

A The Individual Diagnostic Report lists objectives and the student's performance on each active.

B Objectives are abbreviated and numbered for easy reference.

C Objectives are grouped into category objectives.

D Mastery or nonmastery is indicated by plus or minus signs.

E The letter "R" indicates incomplete mastery (review required).

F An asterisk specifies errors or needs in mathematics and indicates where the teacher should begin in identifying the reasons for a student's errors or needs.

NOTE: A blank cell or space indicates that the student did not answer the items.

Appendix C

TEXTS ON BASIC SKILLS IN VOCATIONS WHICH HAVE TESTING MATERIALS BUILT IN

Agricultural Education

Mastering Technical Terms: AG, Power/Auto. Indianapolis: Bobbs-Merrill, 1976.

Mathematics For Agriculture. Publication AG-73 from the New Jersey Vocational-Technical Curriculum Laboratory.

Distributive Education

Donze, J., et al. Distributive Education: Communications. Instructor's Curriculum. ED 170 459.

Logan, W. and Freeman, H. Mathematics in Marketing. New York: Gregg/McGraw-Hill, 1978.

Rowe, K. Communications in Marketing. New York: Gregg/McGraw-Hill, 1978.

Health Education

Hayden, J. D. and Davis, H. T. Mathematics for Health Careers. Albany, New York: Delmar, 1980.

Mastering Technical Terms: Nursing. Indianapolis: Bobbs-Merrill, 1976.

Occupational Home Economics

None

Office Education

Briggaman, J. Practical Problems in Mathematics-Office Workers. Albany, New York: Delmar, 1977.

Bryant, K., Newhouse, H. L., and Handy, R. S. Basic English For Business Communication. Belmont, California: Fearon-Pitman, 1978.

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Mastering Technical Terms: Building Trades. Indianapolis: Bobbs-Merrill, 1976.

Trades and Industrial

Bail, J. Practical Problems in Mathematics-Masons. Albany, New York: Delmar, 1980.

Building Industrial Communications: Listening, Speaking, Writing, Reading. Grade XII. ED 088 053.

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Heppa, V. Math for Masons. ED 164 816

Hoffman, E. Practical Problems in Mathematics-Machinists. Albany, New York: Delmar, 1980.

Huth, H. C. Practical Problems in Mathematics-Carpenters. Albany, New York: Delmar, 1979.

Industrial Communication Reading, Speaking, Listening, Writing, Grade XII. ED 088 051.

Kubala, T. Practical Problems in Mathematics-Electricians. Albany, New York: Delmar, 1973.

Larkin, J. Practical Problems in Mathematics-Mechanical Drafting. Albany, New York: Delmar, 1979.

Mastering Technical Terms: Welding. Indianapolis: Bobbs-Merrill, 1976.

Mathematics For Commercial Foods. Publication FO-114 from the New Jersey Vocational-Technical Curriculum Laboratory.

Mathematics For Cosmetology, Parts 1 and 2. Publications LC-21 and -22 from the New Jersey Vocational-Tecchnical Curriculum Laboratory.

Mathematics for Sheet Metal Fabrication. Albany, New York: Delmar, 1970.

Moore, G. Practical Problems in Mathematics-Automotive Technicians. Albany, New York: Delmar, 1979.

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Words At Work: Auto Mechanics. Norwalk, Connecticut: MIND, n.d.

General Vocational

Curriculum Committee of St. Paul Technical Vocational Institute. Arithmetic For Careers. Albany, New York: Delmar, 1979.

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Appendix D

READABILITY ANALYSES AND RESOURCES FOR DOING THEM

Analyzing Printed Materials to Determine Readability. Module Two of the Teacher Training Program for Vocational Teachers. Tallahassee: Florida State University Vocational Reading and Math CBTE Program, undated.

Butz, R. and Gunabalan, L. Vocational Reading Power Manual (Revised). Minneapolis: The EXCHANGE, 1978.

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PROJECT STAFF

James A. Dunn, Director

RESEARCH ASSOCIATES	RESEARCH ASSISTANTS	SECRETARIAL STAFF
Vernon Beuke	Terry Delage	Susan Alexander
John Bowers	Philip Harrington	Sharon Bobnick
Robert Frank	George Hoagland	Madeline Dean
Peter Gray	Eva Kaufman	Rita Menapace
Cheng Liu	Patricia Kuntz	Cynthia Moore
Dennis Ridley	Tracy Locke	Lois Snyder
Lynn Rycroft	Elizabeth Martini	Michelle Woodcock
Clinton Walter	Lucy Savitzky	